SUPPLEMENT.

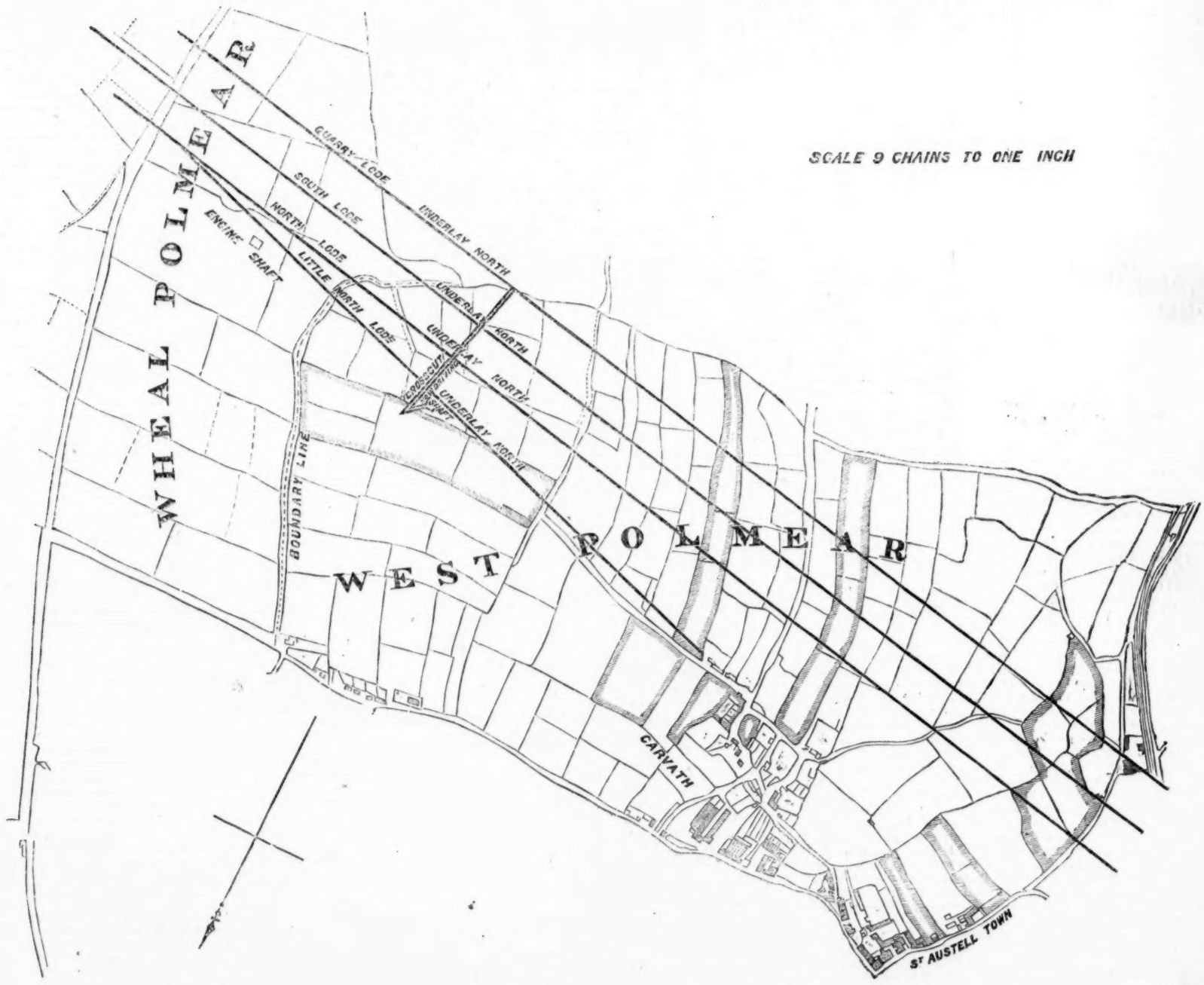
The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1340.—Vol. XXX.] LONDON, SATURDAY, APRIL 27, 1861. [WITH JOURNAL] STAMPED.... SIXPENCE. UNSTAMPED. FIVEPENCE.

THE POLMEAR MINING DISTRICT—WEST POLMEAR MINE.



SCALE 9 CHAINS TO ONE INCH

WEST POLMEAR.

This mine is situated in the parish of St. Austell, Cornwall; is divided into 6000 parts, or shares, and conducted on the Cost-book Principle. The sett is about ¾ mile in length on the course of the lodes, and about ½ mile in width. It is adjoining that successful young mine Wheal Polmear, is on the course of the same lodes, and the boundary of this sett is within 60 fms. of some of the most productive points of that mine. The formation through which the lodes traverse is of the most congenial description, being a beautiful light blue clay-slate; and, according to the opinions of the well-known practical agents, whose report is appended, the lodes can scarcely fail to be productive when intersected in such a stratum.

By referring to the above plan, it will be seen that the same lodes traverse both the Wheal Polmear and West Polmear Mines. The dotted line will show the division of the setts, and the shafts in each mine will show the position of the works. The line drawn across the lodes is the line of the cross-cut now being driven south to intersect the lodes, which, in consequence of the very favourable nature of the ground, will be accomplished in comparatively a short time. The mine has been carefully inspected by the agents whose report is given below, for Mr. P. Clymo, of Liskeard and the South Caradon Mines, and Mr. W. West, of St. Blazey, both of whom are interested in this undertaking. There is a valuable plant on the mine, equal to its requirements for a considerable time, as detailed in the annexed report. The mine is divided into 6000 parts, or shares, with 10s. per share paid thereon, which has paid for the four steam-engines, and all the plant on the mine, and leaves a balance of about 1000*l.* to be applied to the development of the works. Any further sum which may be required will be subscribed by the whole of the shares.

It must be seen on a careful review that the undertaking has prospects of no ordinary character, and that the chances of having a successful mine are much greater than usual. The undertaking will be conducted on the best and most economical principles of mining, under the supervision of the gentlemen named, whose reputation is a sufficient guarantee for the conduct of the works. Mr. H. W. Higman, of St. Austell, Cornwall, is the purser of the mine, and Mr. W. Charles, of 27, Austinfriars, London, E.C., is the referee of the mine in London, either of whom will give any further information on application.

April 15.—We have to-day inspected this mine, the following is our report: We find this sett is about three-quarters of a mile in length on the course of the lodes, and half a mile in width. It adjoins the western boundary of Wheal Polmear, contains five visible lodes, and is within about 60 fms. of some of their productive workings. The engine-shaft is sunk 20 fms. below the adit on the course of the Gewan's lode, and levels extended east and west on its course 40 fms., the lode varying in size from 2 to 4 feet wide, containing tin and copper; in this level a cross-cut is driving south which will intersect the lodes they are raising so much ores from in Wheal Polmear. The distance to drive to intersect the first will be about 35 fms., and 20 fms. more driving will intersect two others, all of which are seen in the adit, varying in size from 2 to 4 feet wide, and of a very promising appearance, and in a similar stratum of ground to the adjoining mine, which is very easy for exploring—prices for driving from 3*l.* to 4*l.* per fm. There is a 38-in. pumping engine, stamping engine with 36 heads attached, winding ditto, rotary ditto, for pumping and drawing, with pitwork and other materials ample to prove the mine to a great extent when required. In conclusion, we would remark that we see no reason to doubt but that this mine will prove equally productive to the shareholders as the adjoining mines, and we strongly recommend a vigorous prosecution.

William Rule, South Caradon.
Henry Hodge, Wheal Mary Ann.
William Hancock, Wheal Wray Consols.
Francis Puckey, Par Consols.
Richard Hancock, Polgooth.

Original Correspondence.

UTILISATION OF BLAST-FURNACE GASES—No. II.

Ebelmen analysed the gases of two charcoal furnaces, those of Clerval and Audincourt, also two coke furnaces at Vienne (Isère) and Pont l'Eveque, near Vienne. From his experiments he draws the following conclusions with regard to charcoal furnaces:—1. At a short distance above the tuyres the oxygen of the air is completely transformed into the oxide of carbon. From a point about 1 ft. or 18 inches higher up, to the widest part of the boshes, no trace of carbonic acid is to be found; but at this point it reappears, and goes on gradually augmenting until about half-way between its place of production and the mouth of the furnace, where it remains constant. All this while the proportion of oxide of carbon has been diminishing. In the upper part of the furnace the materials charged are dried and calcined. Five-sixths of the oxide of iron are reduced in the lower part of that portion of the furnace comprised between the greatest diameter of the boshes and the mouth by the oxide of carbon; the remaining sixth is reduced in the boshes, and, in fact, its reduction is scarcely complete till it arrives in the hearth. The reduction in the last case is due to the direct contact with the coal, and is accompanied by a great consumption of combustible, while the former occasions no loss whatever. The carburation of the iron takes place at the same time as the final reduction.

From the greatest diameter of the boshes, to the mouth of the furnace, the coal loses only those products of which the existence is attributable to a calcination in a closed vessel, no reaction taking place between the coal, the mineral, and the carbonic acid. The quantity of hydrogen steadily augments from the boshes to the furnace-mouth. It is produced from the water drawn in with the blast, and that proceeding from the coal. It exercises no influence in the furnace, and is found in its totality at the mouth. The complete calcination of the limestone is effected at the greatest diameter of the boshes.*

These considerations have special reference to the charcoal furnaces above mentioned; still they apply generally to those working with coke, with this difference, that the temperature in the latter case being, according to Ebelmen, more elevated than in the former, the various phenoma take place sooner, or higher up in the furnace. Hence the reduction of the ore and its calcination, as well as that of the limestone, take place in the upper rather than the lower half of the body of the furnace. The zone of oxidisation or fusion is also higher up.

There is a want of coincidence in the results obtained by Ebelmen and those arrived at by Bunsen and Playfair which did not fail to elicit comment. In the first place, Ebelmen found no protocarburet of hydrogen ($C^2 H^4$), which is surprising, since this gas is produced by the distillation of charcoal. The explanation of this fact offered by Bunsen and Playfair is probably correct—the manner in which Ebelmen made his analyses, which was in directing the gases on the oxide of copper at a red heat in the ordinary manner, instead of making use of the eudiometer—the instrument that they employed. But the most important point of difference was, that between a point near the tuyeres and the zone of reduction of the ore and calcination of the limestone Ebelmen found no carbonic acid, while Bunsen and Playfair reported its presence in considerable quantities in the same place. However, in another and final analysis of the Alfreton furnace gases these gentlemen admitted the absence of this gas in the regions where they had previously detected it; it is, therefore, probable that Ebelmen was in the right, and that the presence of the gas in the first instance was owing to some abnormal cause.

Now, though there may be doubts entertained as to the perfect accuracy of these experiments in all their details, they still seem to establish the fact that there is a point at which the reductive and combustible gases are of no more use in the interior of the furnace, and that were the furnace tapped at this place no ill effects could follow the mere abstraction of its gases. But even if we concede that the presence of these gases is more or less essential during their entire sojourn in the furnace, it must be admitted that it has ceased to be of use from the moment of their final escape in the atmosphere, and that their ignition or non-ignition then becomes wholly impotent to affect the process of smelting the ore; and, in fact, they *are* ignited, as the long flame which at night is seen issuing from the furnace throat incontrovertibly proclaims; and the question then is, should they be thus wastefully burnt in the open air, or under a boiler, or in a puddling-furnace? Did the subject at issue hinge on the first objection only—that the mere absence of the reductive gases at any part of the furnace interfered with its working—I think, from what has been stated relative to the facts of the case, we might safely conclude that all opposition to the utilisation of such gases as a combustible had fallen to the ground; but there are other difficulties which present themselves, and their systematic discussion leads us to objection No. 2 on our list. The draft of the furnace is unquestionably modified—it remains to decide, if possible, whether the modifications act injuriously, advantageously, or immaterially. The contraction of the means of egress furnished the gases by the appliances used to collect them, and which amounts practically to a diminution of the diameter of the throat, so far as draft is concerned, produces three results—a retarded draft in the body of the furnace, and an accelerated one at the mouth, with an increased pressure on the contents of the furnace. The truth of these statements may be tested by breathing through a blow-pipe alternately with and without the nose-pipe. The friction developed by the gas in passing through the tubes, often of a considerable length, by which it is conveyed to the fire-places, and also the absorption of momentum occasioned by forcing gases, of which the natural tendency is to rise, down to a lower level, tend greatly to diminish the draft, and these retarding influences are overcome—first, by the erection of lofty chimnies; and, secondly, by augmenting the pressure of the blast. This last method is in many cases attended with good results, as in the smelting of refractory ores, for, besides introducing an additional supply of air, the pressure and velocity are increased—circumstances favourable to the combination of the oxygen with the carbon of the fuel. The draft would be the principal function of the furnace altered by *this kind* of contraction, and the full discussion of the effects produced by a change of draft would lead me from the present subject to that of the construction of the blast-furnace. Suffice it to say, for the moment, that the study of the effects of form on the draft may be founded on the consideration that were the interior of the furnace perfectly cylindrical the draft would be stronger in the lower regions than in the upper, since the gases diminish in volume as they ascend, therefore at the mouth the volume that passes at a given moment is less than that which is passing at the same instant at the boshes. If, however, the furnace is not cylindrical, but cone-shaped, and the throat smaller than the difference of volume due to the reduced temperature, this excess of velocity would be reversed; and, to change from the positive to the negative sign, it must at some time, depending (all other things being equal) upon the relation between the two diameters of the truncated cone, pass through zero, and this relation would be that at which the velocity of the ascending column of gases would be at all points uniform.

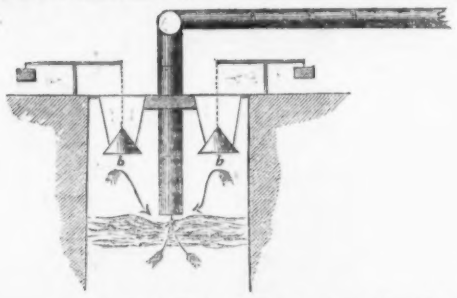
It is needless to say that this theoretical form could never be exactly hit in practice, even were it desirable to do so, which it is not, as varying circumstances would cause corresponding variations of volume. Be that, however, as it may, if the throat, from any cause, be so contracted as to cause combustion in the upper zones, we may pronounce such contraction as injurious. It would be a nice calculation, and one varying with every particular case, to decide what change is produced in the working of the furnace from the alteration of the draft by the means employed to collect the gases; whether such change is injurious; and, if so, whether the damage is compensated by the economy of fuel. While I am on this head, I may as well anticipate the conclusion I intend to draw, by observing that in my opinion this question of draft is the most important one connected with the subject, and that when the working of the furnace is compromised by the utilisation of its gases, it will be found in many cases to be owing to an interfered with draft.† On the other hand, there are furnaces, M. Valerius particularly cites those of Berg, Luxembourg, where, to translate the words of this learned author, the deviation of the gases does not affect the working of the furnace, the consumption of combustible, nor the quality of the crude iron.

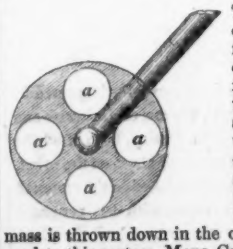
I pass now to the consideration of the opposition contained in the second class of objections; and first, as to the danger attending the withdrawal of the gases, which would arise from their explosive nature. There are two ways in which these gases may be applied—the old-fashioned method being to plant the boiler in which it was proposed to generate steam on a level with and near the furnace mouth, and then heat it by the *flame*, which, caused by the *ignition of the gas at the mouth of the furnace*, was led under it. This system, from its evident awkwardness, has been generally replaced by that in which the gases are led down in hermetic tubes to the boiler, puddling-furnace, or hot-air stove, they are destined to aliment. So long as these gases are kept perfectly intact from all mixture with the air, they are neither combustible nor explosive; when so mixed they are both. It is, therefore, of primary importance that they should be guaranteed from all contact with the atmosphere until they reach the point where it is intended to burn them. If properly managed, I do not think that the conveyance of the gases is attended with much danger, though some of the precautions used to diminish the force of explosions, should they occur, tend rather to provoke such a catastrophe. For instance, the placing of valves in the tubes through which the gases pass, which valves, closed in ordinary times by their own weight, are thrown open by the shock of the explosion, and give vent to the gases which it engenders. This system seems to be of very questionable expediency—first, because the valves at best but imperfectly fulfil their proposed functions, the egress they furnish being too insignificant when compared to the volume of gases instantaneously developed by the explosion; and secondly, because on the principle that prevention is better than cure, it seems unadvisable to have any openings on the conduits, which, from imperfect workmanship, might, as I have already said, produce the very accident the evil effects of which they are intended to mitigate, by allowing the admission of air. In this connection I translate the following remarks from a *mémoire* written (1848) by MM. A. Clement-Desormes, director of the Oulins workshops and forges (near Lyons), and A. Dubu, director of the blast-furnaces and foundries of La Mulatiere (also near Lyons), relative to the applicability of the patent laws to the utilisation of furnace gases:—"We declare that during the ten years we have been constantly occupied about blast-furnaces we have witnessed many explosions, and that these explosions have never presented the slightest danger, either to the workmen or apparatuses, and all directors of works accustomed to these gases will testify the same."

We have now to consider whether the supply of gas is of too precarious a nature to be counted on for furnishing a constant combustible. For *puddling* I think it is. It is supposed, however, by some authorities that by uniting the gases of two *charcoal* furnaces in a species of reservoir, where an agitator would give the mass the requisite homogenity of composition, they might be successfully used for such a purpose. It is to be regretted that the gases do not admit practically of application to puddling, since a gaseous combustible is infinitely superior for that operation to a solid one, on account of the smaller waste of heat it occasions. Another inconvenience is the deposits of dust and cadmus which are formed in the tubes, &c. Some of the principal conclusions arrived at from the experiments made in 1843, at Berg, in addition to those already mentioned are as follows:—The application of the gases to puddling occasions not only the economy of all other combustible, but also saves 8 per cent. of waste in the matter converted. In addition to the blowing apparatus of the furnace it is necessary to furnish as much air to the puddling-oven as would be required for a large finery; and as a vital condition, the appliances by which it is introduced should work with the greatest possible regularity. The highest pressure at which they should be blown with hot air is from 1½ to 2 in. of water, the pressure on the furnace-blast being at the same time from 9-10ths to 1 1-10th in. of mercury. The cost of an oven adapted to burn gas was estimated at about 80*l.* more than an ordinary oven burning raw coal, to which, however, must be added the cost of the fittings-up used to lead down the gases from the furnace. At first an inconvenience was experienced from the shoot of flame that the interior pressure caused to issue from the eyelet in the oven door, but this was remedied by a horizontal fan-shaped jet of cold air, which cuts the flame at the height of the eyelet. The extra repairs, &c., necessitated by the use of this kind of fuel, were fully compensated for by the economy of ordinary combustible.

In spite, however, of all experiments, it is evident that the day has not yet arrived for the current employment of blast-furnace gases in puddling. There is too much irregularity and want of homogenity in the supply of combustible furnished by the furnace, to make it a safe dependence for a delicate operation like puddling. For heating boilers the case seems different. When they are provided, as they should always be, with supplementary fire-grates, on which coal may be burnt in the ordinary manner, when the supply of gas from any cause relaxes, and also with the means of regulating and diminishing the affluence of air when combustion becomes too energetic from a temporary surproduction of gas, the utilisation of waste heat in this manner affords a genuine economy, subject, however, to modification from considerations contained in article third and last—whether, taking into the calculation the cost of the fuel which would otherwise be employed in getting up steam, any real saving is effected by this economy of combustible? This is a question which does not admit of a general solution, but which must be decided by every director of furnaces in a particular manner, to suit his particular case, from a close inspection of his coal account. Those works which can dispose of a large amount of comparatively unmarketable small coal, particularly if it be non-coking, can derive but little advantage from such methods; while the immense number of furnaces, particularly on the Continent, where coal is dear, and much of the fine used in the manufacture of *agglomérés* and coke, of which the gases are all thus utilised, proves that, in many cases, a veritable saving may be effected by their employ. I am not inclined to attach a very great weight to the first outlay required for fittings-up, &c., though it may sometimes reach a considerable figure. If a steady economy of fuel per ton of iron produced is attained, this expense would be soon struck off the books.

A word in regard to the manner of taking the gases—there are several ways in which this may be accomplished, but the most advantageous by far seems to me to be that in use at Commentry, in France, by which the gases are not collected until they have quitted all connection with the load





The apparatus consists, at least in principle, of a sheet-iron tube, which plunges about a fathom in the furnace-mouth, directly in the centre. The furnace is charged by means of four funnels, sunk symetrically around the tube. They are closed from the bottom by sheet-iron cones, kept in place by counterweights. When the load is emptied on these cones they sink, and allow the charge to slide off them, when they assume their primitive position. In this manner the charges are more evenly distributed than when the whole mass is thrown down in the centre, where it forms a large mass. In regard to this system, Mons. Coingt, of Commentry (the introducer of wide-mouthed furnaces at those and other works), in a note published in the *2me Livraison, tome* iv., 1858, of the "Bulletin de la Société de l'Industrie Minérale," says that with it he endeavoured—1. To keep the furnace mouth constantly closed, in order to avoid the combustion of the gases. —2. To operate mechanically the charging of the furnace.—3. To collect all the gases produced without sensible interruption to their free circulation, by means of the central aperture (*prise centrale*), which plunges to a depth of 2 metres, about 1 fathom, in the axis of the furnace. Contrary to the effects produced by the ordinary system of charging, the materials loaded are evenly distributed around this *prise* and the sides of the furnace. With this system applied to all the furnaces of Aubin, Commentry, and Montlucon, and, lastly, two new charcoal furnaces which he has constructed, Mons. Coingt has succeeded, he says, in obtaining regularity of working, without interfering with a heavy production, with the smallest possible consumption of fuel, and collecting at the same time the totality of gases produced, which suffice, without addition of coal, for heating the hot-air stoves and the boilers of the blowing engines.

Where it is purposed to use the gases of a group of furnaces, it is much the best plan, when practicable, to unite them first in a common reservoir, whence the boilers would derive their supply, which would thus be much more regular, both in quantity and quality, than if each furnace were drawn on separately.

I would not have the foregoing remarks induce a belief that I am a one-sided partisan of the utilisation of waste heat. The prime object for which fuel is put into a furnace is to smelt the ore, and not to be transformed into a gaseous combustible. If in fulfilling its legitimate object it is so transformed, and its utilisation in this shape does not interfere with the smelting, *so much the better;* but this is essentially a secondary consideration, and the grand principle in this, as in all other industrial enterprises, is the utilisation of *secondary products* in a *secondary manner*.

E. SHERMAN GOULD,
Ancien Elève de l'Ecole des Mines de St. Etienne.

"OLD BONES."

There is, probably, no branch of study which more amply repays those who diligently pursue it than Natural History; yet, from this very circumstance, no science is so undeservedly neglected. It will be at once acknowledged that to be enabled to write an essay upon any subject which shall at the same time instruct and entertain the reader, the author must be not only thoroughly competent for his task, but must have the skill to descend to the level of the minds of those for whom he writes, and then gradually raise them with him until he has imparted to them all the knowledge in his power. Now, in the study of natural history, according to the ordinary system, there are many tedious mountains to ascend, and many lands of drought to traverse, before the wished-for fertile plains are attained; and when these are at last reached the traveller is so rejoiced at the beauty of all before him that he at once forgets the many difficulties he has encountered, and indulges in the belief that anyone but him would have met the many obstacles with pleasure, and passed by them without a thought. Hence, in whatever attempts he may make to enable others to participate in the pleasures of studying Natural History, he is prone to pursue the beaten track which has led him to his destination, and in consequences hold out little encouragement for others to follow him. The author, however, of "Old Bones,"* in the first place, reminds us that "Nature's truths are 'whispered rather than outspoken,'" and then proceeds to give us abundant evidence that he is both able and willing to interpret those whisperings into a language which shall be understood by all.

Recent naturalists divide the animal kingdom into five sub-kingdoms—*Vertebrata*, comprising those animals that have a back bone and internal skeleton, as man, birds, reptiles, and fish; *Mollusca*, soft bodied animals, including the nautilus, the *extinct* ammonites, mussels, oysters, &c.; *Articulata*, jointed animals, as insects, centipedes, lobsters, and the extinct trilobites and eurypteri; *Radiata* (or *Cœlenterata*), rayed animals, including sea-cucumbers, star-fish, corals, the extinct pentremites, &c.; and *Protozoa*, minute beings retaining the form of nucleated cells, which manifest the common organic characters, but are without the distinctive superadditions of true plants or animals, including sponges, infusorial animalcules, &c. These plans of animal architecture are altered and modified in a thousand ways. However ungallant, it is more necessary to separate the "lassie fair and gentle" from the nightingale and dove than from the hippopotamus or whale; while the winged butterfly of the air is far more nearly allied to the centipede or scorpion than it is to the humming bird or bat. The sub-kingdoms, therefore, are divided into classes, orders, families, genera, and species. Vertebrate animals are divided into four classes —Mammals, birds, reptiles, and fishes; and as these are the only members of the animal kingdom possessed of bones, according to the common acceptation of the term, it is to these, of course, that the author of "Old Bones" confines himself.

In treating the class Mammalia, Mr. Symonds adopts the recent classification of Prof. Owen—the very philosophic one of dividing them according to the character of the brain:—*Archencephala*, perfect brained; *gyrencephala*, convolute brained; *lissencephala*, smooth brained; and *lyencephala*, loose brained. In the sub-class, *archencephala*, but one order, *bimana*, is included, and the only representative of this order (man), stands alone, and entirely separated from all other individuals of the animal kingdom, Prof. Huxley's view, that there is a connection between man and monkeys, being untenable, the argument that "the difference between man and the highest monkey is not so great as between the highest and the lowest monkey" proving nothing, whilst we have only to accept Prof. Owen's statement (which no one has attempted, we think, to disprove), that "the posterior lobes of the cerebrum in man presents parts which are wholly absent in the gorilla," and the correctness of his conclusions will be at once apparent. The earliest record of the existence of man as an inhabitant of this planet is immensely posterior to the Eocene period in which the oldest known ape, the Eopithecus, is known to have lived. Our first knowledge of man is that he appears as a reasoning being. Apes were apes myriads of ages before we have any evidence of man's existence, and are apes still.

Amongst the Gyrencephala we find no less than eight orders, the gradations connecting the highest apes with the dolphin. First in the sub-class of gyrencephalous animals stands the *quadrumana*, four-handed animals, including the monkeys of the old world, American monkeys, and lemurs; these three families being named respectively *catarhini*, *platyrhini*, and *strepsirhini*, and composing the second order of mammalia. The apertures of the nostrils in these groups present distinguishing features. The gorilla offers the nearest approach to man of any known ape, recent or fossil. Fossil remains of monkeys have been found in deposits of the tertiary ages of India, France, Greece, and England. Pithecus being the Greek name for monkeys in general, the fossil genera are named eopithecus, pliopithecus, dryopithecus, &c., according to the characteristics exhibited by their fossil remains, or the age of the deposits in which they are discovered. Extinct species have been discovered in strata of the Eocene period. Eocene is the term invented by Sir C. Lyell for the lowest and most ancient groups of those tertiary rocks which succeed the secondary group of deposits in stratigraphical position, and in which the prototypes of almost all existing mammals for the first time make their appearance. Eocene means the *dawn* of recent animals. The Miocene deposits contain fewer recent animals than the pliocene; while in the Pleistocene deposits, which are the latest of the pliocene, more than three-fourths of the fossils are of existing species.

Below the quadrumana comes the *carnivora*, forming the second order of the sub-class gyrencephala, and the third of mammals. This order comprises also three families—*digitigrada*, toe-walkers, including the lion, weasel, &c.; *plantigrada*, flat-soled walkers, as the bear, racoon, and badger; and *pinnigrada*, fin-footed, including the seal, morse, &c. It is well for the tyro to become acquainted with the structure of the carnivorous jaw, and to study its adaptation for the destruction of other animals; the first step should be to obtain a knowledge of teeth, and the difference between incisors, canines, and molars. Living examples of the digitigrada carnivora may be seen in the gardens of the Zoological Society. Lions of Asia and Africa, the tiger now purely Asiatic, and their American representatives, will be found there, and those who have seen the fossil relics of our English caves, the bone caves of the geologist, will look with interest at the hyenas when they remember that thousand of these animals have left their remains, and that they were formerly denizens of Great Britain. The plantigrada is represented by bears, racoons, badgers, &c.; the latter animal, though once abundant in England, will probably soon become extinct here. As far back in pre-existing ages as the middle of the secondary epoch there were insectivorous mammals, and in the miocene period there lived, says Prof. Owen, "in England and continental Europe a peculiarly destructive feline quadruped, with the upper canines much elongated, trenchant, sharp-pointed, sabre-shaped; it was represented by species as large as a lion, and by others of the size of the leopard." These destructive carnivores lived on to the later tertiary epochs, were the contemporaries of the gigantic cave bear and hyena, and the slayers of extinct oxen and deer in ancient England. Animals allied to the dog and fox have been found fossil, and a species of hyena was very numerous formerly in England. Huge carnivores must have swarmed Great Britain during the mammoth period, and now the only representative of the dog tribe is the fox; the tiger and lion, the wild cat; and the bear, the badger.

The third order of gyrencephalous animals is *artiodactyla*, or even-toed

---

* It is to be regretted, for the sake of precision, that we do not have a separate name for every part of the interior of the blast furnace, corresponding to the French terms of *creuset, ouvrage, étalages, ventre cuve*, and *guenlard*.

† Interfered with not only in respect to its velocity, but also, and more particularly, from having its direction changed. When the escape openings are on the sides the gases tend to *envelope* the load, instead of penetrating it, thus depriving the mass of the ore of their reductive properties. The air in this case probably feels the bias almost immediately on entering, and sweeps up along the sides of the furnace, particularly when the form of this latter is cylindrical. If, on the contrary, the orifice be placed in the centre, in the manner that will be shortly described, the current is concentrated, and passes through the heart of the charge. This is the only way in which gases should be collected. The effects of the two systems may be compared to those of the centrifugal and centripetal forces—one being a *throwing off*, and the other a *drawing in*.

* "Old Bones; or, Notes for Young Naturalists." By the Rev. W. S. Symonds, F.G.S. London: Hardwicke, Piccadilly.

(two or four) animals, and comprises two families—*non-ruminantia* (not chewers of the cud), amongst which the most familiar example is the pig; and the *ruminantia* (chewers of the cud), including the deer and sheep. The pig is the existing representative of a very ancient race of mammals; the same species of wild boar that was hunted by our forefathers was contemporary with the mammoth, the cave bear, and the long-haired rhinoceros. The wild ancestor of our domestic pig was in existence before the separation of England from the continent of Europe. Mammoths, tigers, and rhinoceroses perished, but the wild boar lived and lives still. The chewers of the cud are of all animals those which are most useful to man. A species of aboriginal British ox, with very short horns and long fronted head, was co-existent with the ancient Britons, and is believed to be the progenitor of our domesticated cattle. A gigantic ox, and a large species of bison, also existed in England. Under the fourth order of gyrencephala, which is the fifth of the class mammalia, and designated *perissodactyla* (odd-toed animals), are contained two families: *solipedia* (solid-hoofed), including the horse, and *pachydermata* (thick-skinned), including the rhinoceros. When the Spaniards discovered America no horse was in existence throughout the length and breadth of that vast continent, but, being introduced, has run wild, and in South America abounds in large herds. Yet America had formerly a horse, which became extinct before the days of the Incas and the Indians, and the remains of which are imbedded with enormous American sloths and other animals, which are themselves extinct. A representative of the horse lived in the Eocene period, and there were some extraordinary forms—one called hipparion, a three-hoofed horse; and another a beast between the horse and the rhinoceros, which lived in the days of those miocene tertiaries when volcanic action was rife in the North of Ireland and West of Scotland, and in the plains of Central France. The coney of the Bible is the hyrax of naturalists, and is a diminutive hornless rhinoceros, about the size of a rabbit; it inhabits rocky places in Africa. Ancient as is the coney of Scripture, there was one still older, for a hornless rhinoceros, or gigantic hyrax, lived in the miocene period.

The next order, *probiscidea*, is personified by the elephant, of which there are two living species, the Asiatic and the African, differing in the size of their ears and the structure of their teeth. In former ages these majestic animals were common in England, there being scarcely a county in which their fossil remains have not been found. At Ramsgate there is a collection of tusks which became entangled in the nets of the fishermen off the mouth of the Thames; while near Brighton is an "elephant bed" containing the remains of hundreds of extinct elephants of every size and age; and we are almost as sure of finding portions of the teeth or bones of the mammoth in glacial gravel or drift as we are of finding the remains of extinct reptiles in the lias. Passing the *toxodontia*, an extinct family, three species of which are known from rocks of recent tertiary deposit in South America, we come to the *sirenia*, mermaid animals, with which the toxodontia were probably allied. Of the *sirenia*, which forms the seventh class of gyrencephalous animals, and the eighth of the class mammalia little is known. The name is given to the group from the mermaid appearance that they present when swiming in the water, nursing their children, which they hold encircled by one arm. Their appearance, however, out of the water is far from lady-like, as they look very like a seal endeavouring to be developed into an hippopotamus. The *sirenia*, though now so small a group of animals, were once very abundant and widely distributed throughout Europe, especially during the miocene period. The subclass gyrencephala closes with the order *cetacea*, whale-formed animals, which includes the whale, porpoise, and dolphin. The formation of the dolphin's brain is so remarkable, and indicates so much intelligence, that the author of the "Vestiges of Creation" fixes on the dolphin as the sea-inhabiting progenitor of the monkey family, and, through the monkeys, of man. The dolphins are of ancient and time-honoured family, for three or four species have left their remains in the miocene deposits.

The third sub-class of mammals, *lissencephala*, includes four orders—the *cheiroptera*, or hand-winged animals, of which the bat is a representative; the *insectivora*, insect eaters, including the hedgehog, shrew, and mole; the *edentata*, animals wanting teeth in the fore part of their jaw, of which the sloth, armadillo, and ant-eater are representatives; and the *rodentia*, the best known representatives of which are the rat and hare. Bats are divided into two families, the frugivorous (fruit-eaters); and the insectivorous (insect-eaters), the molar teeth of the former resembling those of monkeys, and the teeth of the latter those of the insectivorous shrews and moles. The earliest known insectivorous mammal is of immense antiquity, and the family of insectivores are all represented by extinct fossil genera. The order edentata is divisible into four families, represented by the sloths, armadillo, ant-eaters, and the extinct megatheroids—most of these are confined to South America. The rodentia, gnawing animals, instead of canine teeth have strong chisel-shaped teeth in front, and molar teeth behind. The brain of rodents is very like that of the insectivores. The common beaver, well known by the wonderful instinct which it displays, is a rodent. Beavers formerly lived in Great Britain, and were not extinct in Wales until after the time of Oliver Cromwell.

The consideration of the great class mammalia is closed by the lyencephalous, or loose brained, animals, the living representatives of which are chiefly confined to Australasia. The sub-class lyencephala contains two orders—*marsupialia*, pouched animals, the representatives of which are the opossums and kangaroos, and the *monotremata*. The marsupials are remarkable for the premature production of their young, the young of the kangaroo, for instance, being only an inch long at their birth, when they are transferred to the pouch. They are divisible into two groups, the flesh-eaters of which the opossum and thylacine (tiger-wolf) are representatives; and the plant-eaters, of which the kangaroos, wombat, and Australian bears are representatives. Although now confined as stated, the marsupials formerly existed in Europe and elsewhere, fossils of such animals having been found in the lias both in Europe and America. Of the order *monotremata* only two genera are known, the duck-billed ornithorhynchus and the echidna. The duck-bills are the water-moles of the Australian colonists, and the echidna is a representative of the ant-eaters of South America.

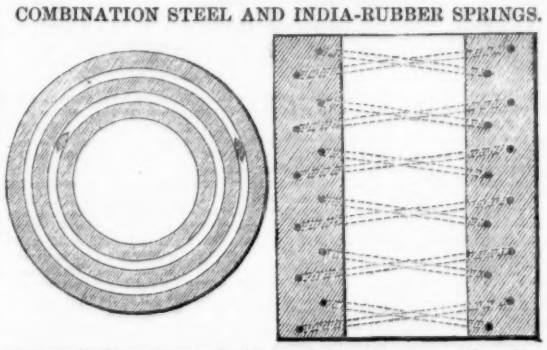
The pleasing and highly interesting style of Mr. Symonds's work is such that no sooner is its perusal commenced than the reader becomes gradually and imperceptibly entwined in the beauties of the subject, and willingly continues his course, until at last, upon reaching the concluding pages of the work, he finds that he has attained so complete a knowledge of the principles of one of the most entertaining sciences, that he will feel an irresistible desire to pursue his studies to the highest possible point. We have attempted an abstract of the portion of the work relating to mammals, and although we cannot now continue it through birds, reptiles, and fishes, we trust we have so far succeeded in giving a sketch of the character of the book that all desirous of studying the science of nature will carefully peruse it. We can unhesitatingly say that from no work upon the subject which we have seen will an equal amount of information be obtained so entirely without labour and in so short a time.

ANCIENT GEOLOGY—No. IV.

Granite, the foundation of the earth, the arch upon which the superstructure of its crust is built; this rock, as all our reasoning would have suggested, is one of the strongest as well as one of the most beautiful of the rocks; its masses are composed of materials presenting in some localities light, dark, and shining facts, in others these are shaded pink; but, either rough or polished, it is a very handsome stone, and its uses are applied to all the substantial architecture of man's greatest works. In its natural position as the foundation-stone of the earth's structure it assumes the prototype of its uses and application in after time; and in ornate and fantastic design it has been employed in all the most ornamental, elaborate, and lasting of the human embellishments of the surface of the globe; but with all its permanent and apparently immutable qualities, it appears to have the germ of instability within itself: it is changed, altered, elevated, and moulded into thousands of shapes, and changes the character of all the other rocks and all the surface of the earth, in every direction, so much so that you can scarcely find a hill, mound, crevice, or inequality on the surface of this sphere that is not in some way indebted for its existence to the mutability of the granite; it is, in fact, continually remodelling the earth's surface, and creating all the pleasing diversities and beauties that both go to form the picturesqueness of the landscape and the metallic riches of the rock: this very mutability and change seem to originate our metallic deposits, for without the protean powers of the granite we should apparently be devoid of metal; and the granite, in disturbing and re-arranging the ordinary face of nature, not only adds to the beauty of the earth's surface, but to the metallic riches of its interior.

Where the granite is compact, unshaken, and unmoved, it is unproductive of metals, but wherever the great lines of outburst occur there are found the stores of metal so valuable to man. The great chain of the Andes, with its gold and silver deposits, the silver formed in veins of 70 feet in width, are all owing to the uplifting power that was lodged in the foundation of the earth. The great tin deposits in Cornwall occur in the granite itself, or sometimes in its immediate vicinity, in the slates in contact with it, but where the granite is itself shattered the lines of fracture at right or considerable angles with the currents of electricity are filled with the ores of tin; and where the granite is protruded in masses through the slates, the veins at the bases that are at right angles with the electric currents are principally filled with copper above and tin below. Looking at the origin of things, we may conclude that the oxide of tin is amongst the oldest of the metallic ores; the granite itself is greatly composed of oxygen, and the study of the ancient condition of the earth before the clay-slates were called into existence shows us that oxygen was the great agent that pervaded all matter. No person can say what oxygen is—it has not been analysed, and its components are not known; neither is it known in what form the great disturbing causes that raise and distort the granite and superincumbent strata are deposited. From the sudden outbursts of volcanoes at peculiar periods, it seems almost conclusive that there are great reservoirs of power in the rock, either accumulative or stationary, that explode periodically; and it is probable that the whole pagentry of the metallic kingdom, so wonderfully exhibited in the veins of the rock, the fantastic beauties of which can only be imagined by those who continually make the subject their study, and who view the ores and their sulphides in their recesses, is due to the escape of the gases from the interior of the planet acted upon by currents of electricity under other favourable conditions of Nature;—but of the origin of the metals we will discourse in another chapter.

COMBINATION STEEL AND INDIA-RUBBER SPRINGS.



Among the improvements in the useful arts few are more deserving of public notice than those in India-rubber, which has now become a permanent and very important addition to the staples of commerce. The improvement to which we are about to refer is the insertion, in the process of manufacture, of metallic springs (in spirals) into India-rubber bearing springs and buffers for locomotives and railway carriages, and of metal plates or strips into valves, for use in steam-engines. In springs of India-rubber alone much depends, of course, upon the skill and ability of the manufacturer to prevent the material becoming rigid, and, consequently, more or less liable to fracture from sudden concussions, or from unevenness of the permanent way, for wherever these are met with the fracture of the rubber is very likely to occur. These results will be entirely prevented by the recent improvement, because a spring comprised of the elastic material of India-rubber, combined with that of the metal spring, becomes, in fact, two springs, united together in the process of manufacture, and forms one homogeneous substance, whilst the separate action of both is effectually preserved; thus, the spiral spring acts of itself with the elasticity of the India-rubber, and the steady elasticity of the latter is retained, and at the same time strengthened, by the additional power imparted by the spring embedded within it. In the helical spring the combination of India-rubber will be found useful, not merely in giving greater strength to the spring itself, but also in preventing the elasticity of fine wire from becoming less active by constant use. These springs are the invention of Mr. S. Moulton, of Bradford-on-Avon, Wilts.

FACTS ON THE NATURE AND ACTION OF STEAM.—At the Manchester Literary and Philosophical Society, Mr. J. C. Dyer, Vice-President, read a paper entitled "Brief Notes on the Nature and Action of Steam in relation to Boiler Explosions." He stated that several essays had lately appeared on boiler explosions, wherein discordant theories and opinions are offered on the action of steam in some anomalous cases of explosion, and which may justify the bringing before the society a few established facts and principles relating to the subject, in the hope of arriving at more settled views concerning causes and effects in such cases than appear to prevail at present among our most distinguished engineers. The author objected to the appeals made to Dr. Dalton's theory of atoms for explaining the nature of steam as an elastic force mechanically employed, since the law of definite proportions of Dalton had no reference to elastic vapours, except as to the constituents of the liquors whence they arise. He then cited the fact that water, like steam, is an elastic body, and the pressure would, therefore, be of the same nature and force above and below the water line in a boiler; but that explosions from fractures above or below that line would have different effects, owing to the amount of expansion of water and steam being so widely different when issuing from similar apertures and under the same pressure. Many obscure cases of explosion would be explained by the more or less rapid generation of steam issuing under those circumstances, as set forth in the paper. That free space, when suddenly and amply afforded, is to highly heated water, under great pressure, nearly the same as fire is to gunpowder. And this will account for the most destructive cases of boiler explosions; whilst those of a more harmless nature show that the fractures were small at first, and then gradually extended. He also objected to the term "superheated steam," as being inapplicable to it in any state; because, when steam is in contact with water it will be of the same temperature as the water; and if heated apart from water, the same laws of expansion by heat apply to steam as to air, and neither can be "superheated," though made very hot. Again, steam can never be "mixed up with the water" in a boiler when both are under the same statical pressure, and the steam formed will rise into the chamber, so that the water will always be in contact with the boiler except when steam is drawn off. Still, in rapid escapes, it may drive out water and become entangled therewith, as in many explosions. It having been shown that most, if not all, explosions are occasioned by simple steam-pressure, acting on the weakest parts at first, and thence extending more or less rapidly, it would seem needless to seek for any other cause or force to account for them; yet, in some cases, the effects appear to imply a more sudden and violent action, like that of explosive compounds. In such instances, may they not arise from the actual decomposition of the water by heat alone? Although we have high authority (cited) against this, yet the author held it rash to conclude that water could not be resolved into its constituent gases by direct action of heat from the boiler upon water pressed into contact with the metal plates. It has been proved, long since, that by heat, in the most intense form known to us—that of electricity—water is decomposed, and both of its constituent gases are liberated. Therefore, since no evidence has been adduced to show that this does not take place in any water when so confined and heated, the affirmative may at least be possible, and seems probably, in some instances, as before named. However, he held it desirable that the question should, if possible, be set at rest by experiment; and to this end a method was suggested for putting the matter to a direct test; but he might not be able to make the experiment himself, and hoped it might be done by some one more competent to the task.

INCREASING VALUE OF BRITISH NORTH AMERICA.—At the Geological Society of London, Dr. Hector read a paper "On the Geology of the Country between Lake Superior and the Pacific Ocean," which gave the geological results of three years' exploration of the British territories in North America along the frontier line of the United States, and westward from Lake Superior to the Pacific Ocean. The Rocky Mountains are composed of carboniferous and Devonian limestones, with massive quartzites and conglomerates, followed to the west by a granitic tract which occupies the bottom of the great valley between the Rocky and the Cascade Mountains. The Cascade chain is volcanic, but the volcanos are now inactive; to the west of it, along the Pacific, cretaceous and tertiary strata prevail. The description of these rocks was given with considerable detail on account of their containing a lignite, which for the first time have been determined to be of cretaceous age. This lignite, which is of very superior quality, has been worked for some years past by the Hudson Bay Company, and is in great demand for the steam-navy of the Pacific station, and for the manufacture of gas. Extensive lignite deposits in the prairie were also alluded to; and, like those above mentioned, were considered to be of cretaceous age; but, besides these, there are also lignites of the tertiary period. The general conclusion was that the existence of a supply of fuel in the Islands of Formosa and Japan, in Vancover's Island, in the cretaceous strata of the western shores of the Pacific, but principally within the British territory, and in the plains along the Saskatchewan, will exercise a most important influence in considering the practicability of a route to our eastern possessions through the Canadas, the prairies, and British Columbia.

PRODUCTIVE CARGO OF COAL.—As an instance of how fortunes are at times made by a lucky owner of a ship on the outbreak of a war, an old lumbering North American built ship, owned by an English house, left Cardiff in January, 1860, with 1000 tons of coal on board, for Shanghai. On arriving at her port of destination she was immediately engaged by the British authorities to convey her freight to the North, for the use of the fleet, at 1500*l.* per month. She sailed for the North, and in due course got rid of 600 tons to the various men-of-war off the Peiho. With the remaining 400 tons, as ballast, she was started off to Japan, to fill up and return to the fleet, which she did, and, after again discharging 600 tons, retained the 400 tons left, as before, for ballast, took in some old stores as additional ballast, and sailed from the North for Hong Kong to pay off. The last news of this lucky vessel received from China was to the effect that, in January last, she was seen to discharge 50 tons of Welsh coal shipped on board her at Cardiff twelve months previously on board a steam-transport bound to England. Possibly by this time she may have cleared out the whole of her cargo.

LITERARY NOTICE.

Handybook of Patent and Copyright Law, English and Foreign, for the use of Inventors, Patentees, Authors, and Publishers. By JAMES FRASER, Esq. London, 1861.

Another of these useful little treatises peculiar to our country, which engage to furnish the reader with whatever information he may require, bearing directly or indirectly upon our daily business, and which are now well-known under the name of "Handybooks," has just been published, in which the author has collected a vast amount of information—indeed, all that inventors, patentees, authors, and publishers require upon the laws and practice of patents, of copyright of design, and of literary copyright. In a convenient form it presents the rights, the privileges, and obligations of patents and copyrights, and of the means to be employed to obtain them. In this epitome the author has united with a deep thorough acquaintance with his subject a great aptitude in simplyfying and imparting knowledge—a gift but rare amongst scientific writers. After tracing in an interesting preliminary chapter the origin of patents to the monopolies of the Dark Ages, and their history to the present time, the author proceeds with general rules that affect patents, and furnishes a guide to the Patent Office Library, and gives a brief but terse and comprehensive analysis of our existing Patent Laws, and supplies a chapter of caution, which will be read with advantage by all inventors previously to their venturing upon the important step of taking out a patent.

Had the work gone no further it would have offered a valuable boon to inventors, patent agents, the legal profession, and the public at large; but Mr. Fraser has further extended his researches, and in the compass of rather more than 150 pages has explained the theory and practice of the existing Patent Laws in the British colonies, and also in foreign states. The toil and patience bestowed upon this multifarious investigation is equalled by the author's happy art of imparting useful information in a clear and lucid manner, and simplyfying a difficult and abstruse subject so that even the most uninitiated may proceed without further assistance to secure the rights and privileges he requires. In a few short chapters the student is presented with a precis of these Patent Laws, and at the same time including the necessary information to guide inventors as to the expediency or otherwise of taking out patents in different parts of the world.

In the second portion of the treatise, which refers to artistic and literary copyright, Mr. Fraser has been alike assiduous, and not less successful. The law which gives protection to the author or his publishers and its precise extent and nature, are set forth clearly, but with a commendable conciseness, whether concerning the ordinary men of letters, the dramatist, or the musical publisher.

A chapter is devoted to the law of international copyright, and another to the law of copyright as it prevails in foreign countries. To these are added a summary of the opinions of the great authorities upon the right of foreigners to the benefit of British copyright, with respect to countries not having international treaties with us.

We would especially call public attention to the luminous remarks of Lords St. Leonard's and Brougham, as they will well repay examination, as the rule upon this subject is for the present settled. This useful volume has subjoined to it an appendix, containing interesting statistical details respecting patents, and a review of Charles Reade's "Eighth Commandment" (a treatise on copyright), in which that brilliant, but eccentric, writer sets forth the imperfections and shortcomings of the law of international copyright.

The book concludes with what has been justly said to constitute the peculiar "handiness" of such publication as these—a full and copious index. It is, with much propriety dedicated to Lord Brougham, who, among the multifarious benefits which he has conferred upon the public, has particularly distinguished himself by the zeal and ability he has displayed in the amendment of our Patent Laws.

THE COAL FIELDS OF INDIANA.—An elaborate geological report by Mr. L. Lesquereux, upon the Coal Fields of Indiana, has just been completed for the State Agricultural Board of Indiana. Mr. Lesquereux describes 12 distinct qualities of coal, which he has met with, several of which are of good bituminous kinds, and of ample extent to pay for working; a Cannel valuable for the production of oil is also produced in moderate quantities. With respect to the reputation of coal in the market, he offers some very useful suggestions. It is evident that the success of an enterprise for the working of a coal bank depends as much on the quality of the matter as on the thickness of the bank. There is certainly no country where chemists are so often called upon to give an opinion about the value of coal beds, and where chemical examinations have been pursued with more conscientious care, than in America, and none also where so many fallacious and deceptive valuations on the quality of coal banks have been published. Many proprietors and companies have sustained great losses, and some have failed, entirely from this cause alone; because their coal was in the average (or as it is when delivered to the market) far inferior to what the chemical analyses had led them to expect. Of course proprietors and miners are all interested in giving a good name to their coal, and are all boasting of having the best coal in the country. When they send specimens of coal for examination to a laboratory, they pick out always the best pieces. If in the bank there is, occasionally, a thin layer of pure coal, free from sulphuret, shales, &c., of course it is this part which is selected for the chemist, as showing the average quality of the newly-opened coal bank. It is a voluntary cheat, which helps nothing, and deceives badly the proprietors themselves. For if the true value of a coal were fairly ascertained, it would be easy to know for what purpose it may be used to the best advantage. It would be thus possible to find a market even for an inferior quality, and measures would be taken accordingly. But when a coal has been proclaimed from chemical evidence as being of the very best quality for every purpose, proprietors or companies send it indiscriminately to every market, make bargains with gas-works, iron-furnaces, steam-boat landings, coal merchants, &c., and incur large outlay for their working. And if after a while the coal is pronounced unfit for any of the purposes for which it is used, it loses at once its good name, and is declared good for nothing whatever. Thus the works are stopped, the money is lost, and a coal valuable, perhaps, for a purpose different from those to which it has been applied abandoned as worthless. If these suggestions were in all cases acted upon, we opine there would be less complaints of any particular coal selling at an unreasonably low price in the market, and that consumers generally could be better satisfied than at present.

IRON: ITS HISTORY, PROPERTIES, AND PROCESSES OF MANUFACTURE.—The elaborate article on the iron manufacture, contributed by Mr. Wm. Fairbairn, C.E., LL.D., to the "Encyclopædia Britannica," has just been issued by Messrs. Black in a separate form, in order that the author might have an opportunity of extending and improving the original treatise. Every fact of importance connected with the iron manufacture has been brought down to the latest period; and we unhesitatingly affirm that the eulogium which the *Times* offered upon the entire work as an encyclopædia is in every way applicable to Mr. Fairbairn's volume as a work upon the manufacture of iron.

RAILWAY CONSTRUCTION.—A new and vastly improved edition of Weale's "Rudimentary and Practical Instructions on the Science of Railway Construction" has just been issued. The character of the work is so well known that lengthened comment upon its value is needless; we may state, however, that whether for beginners or for those who have commenced practice, the classes for which the book is intended, no more useful companion can be found. The entire work has been carefully corrected to the present time; and a very valuable addition to Sir Macdonald Stephenson's original work has been made by the insertion of nearly all that is useful in the excellent and expensive work of Messrs. Holley and Colborn.

THE ENGINEER'S MANUAL OF THE HYDROMETER.—A series of very valuable tables, for ascertaining with greater accuracy than has hitherto been possible in ordinary practice the quantity of saline matters contained in sea-water, by Mr. Lionel Swift, R.N., of the *Neptune*, has just been published by Mr. John Weale. It is well known that in working marine engines with sea-water a certain amount of danger arises if it be permitted to become saturated with more than a given quantity of the salts, and that the mode of ascertaining the quality of the water is by the use of the hydrometer. Owing to the circumstance of a mixture of a given bulk of pure water with a given bulk of common salt occupying less space than the sum of the bulks named, the ordinary mode of testing and relying upon the results shown by the instrument is found to be objectionable, because more of the deleterious matters are frequently contained than the hydrometer indicates. Feeling the inconvenience of this uncertain mode of arriving at an important fact, Mr. Swift undertook a series of careful experiments, in order that he might be enabled to construct tables, by means of which the necessary corrections could be easily and quickly made. The result of his labours are now before the public, and we doubt not its merits will be fully appreciated by all connected with the employment of marine boilers.

Works published at the MINING JOURNAL *office, 26, Fleet-street, London.*

PRACTICAL TREATISE ON MINE ENGINEERING. By G. C. GREENWELL. In one vol., half-bound, £2 15s.; whole bound in Morocco, £3 10s. In two vols., half-bound, £3 3.

TREATISE ON IRON METALLURGY. By S. B. ROGERS. £1 5s.

NEW GUIDE TO THE IRON TRADE, OR MILL MANAGERS' AND STOCK-TAKERS' ASSISTANT. By JAMES ROSE. 8s. 6d.

MINERS' MANUAL OF ARITHMETIC AND SURVEYING. By WM. RICKARD. 10s. 6d.; by post, 11s.

TRANSACTIONS OF THE NORTH OF ENGLAND INSTITUTE OF MINING ENGINEERS. Eight volumes: 21s. per volume.

TABLES FOR ASCERTAINING THE VALUE OF TINSTUFF. By Capt. CHARLES THOMAS. 5s.

THE COST-BOOK—TAPPING'S PRIZE ESSAY—WITH NOTES AND APPENDIX. 5s.

TAPPING'S EXPOSITION OF THE JOINT-STOCK COMPANIES ACT. 4s.

TAPPING'S DERBYSHIRE MINING CUSTOMS. 6s.

TAPPING'S HIGH PEAK MINING CUSTOMS. 5s.

TAPPING'S COLLIERY AND ORE MINE INSPECTION AND TRUCK ACTS. Cloth, 6s.

LECTURES DELIVERED AT THE BRISTOL MINING SCHOOL. In wrappers 1s. 6d.; in cloth, 2s. 6d.

COST-BOOK SYSTEM—ITS PRINCIPLES AND PRACTICE. 6d.

MINER'S TABLES. By W. WHITBURN. 4s.

MINING GLOSSARY (SECOND EDITION), 2s.

DEVONSHIRE GREAT CONSOLIDATED MINING COMPANY, DESCRIPTION OF THE MINES AND MACHINERY. 6d.

VENTILATION OF COAL MINES. By J. WALES. 3s. 6d.

REMARKS ON THE GEOLOGY OF CORNWALL AND DEVON. By Capt. CHAS THOMAS, of Dolcoath Mine, Cornwall. 1s. 6d.

ON COPPER SMELTING. By HYDE CLARKE, C.E. 1s.

FORM OF "TACK-NOTE." 5s.

TAPPING'S EDITION OF MANLOVE'S CUSTOMS OF THE LEAD MINES OF DERBYSHIRE. 3s.

GEOLOGY AND MINING—FOUR LECTURES, by GEORGE HENWOOD, 2s. 6d.: by post, 3s.

INVENTIONS, IMPROVEMENTS, AND PRACTICE, OF A COLLIERY ENGINEER AND GENERAL MANAGER. By BENJAMIN THOMPSON. 6s.

COAL MINES INSPECTION ACT. 6d.

CLEVELAND IRSONTONE. By JOSEPH BEWICK. Cloth, 21s.; by post, 21s. 8d.

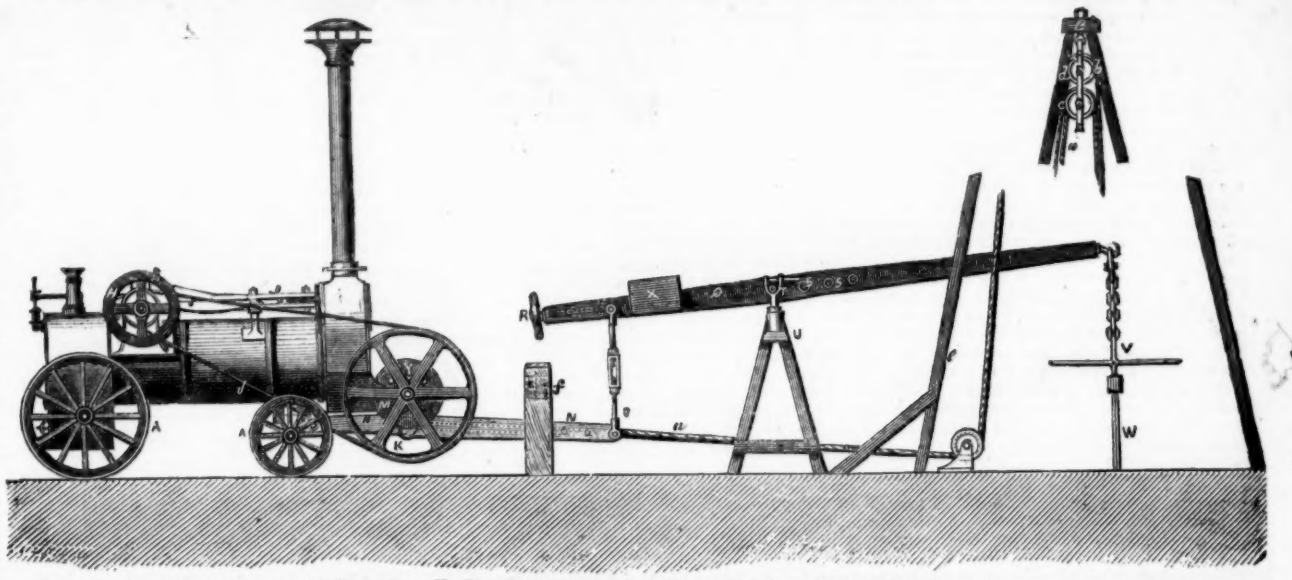
NEW WORK ON GAS, &c. By W. HOPTON. 1s.

ON COAL, AND SOME OF ITS PRODUCTS. By G. BOWER. 6d.

MASTERS AND WORKMEN. By MARK FRYAR. 6d.

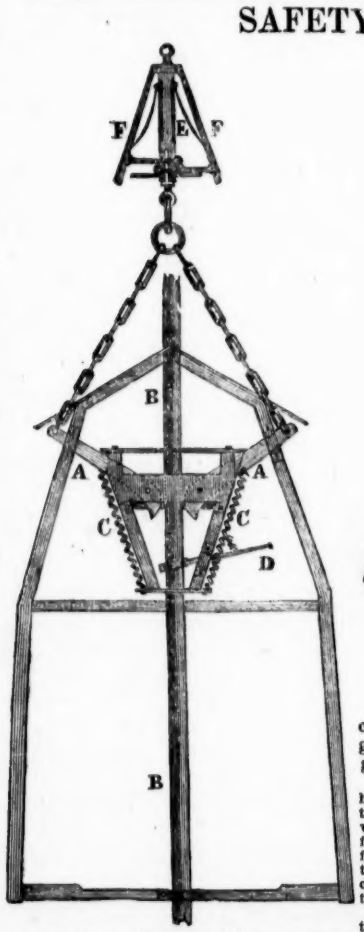
MINING MACHINERY—BORING AND WINDING APPARATUS.

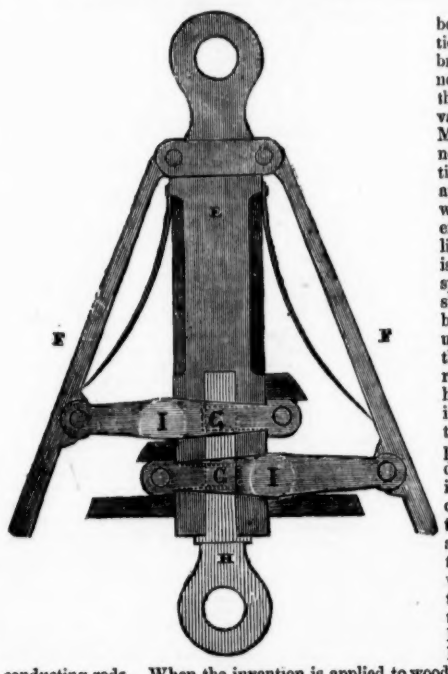
Mr. J. Hunter, of Coltness Iron-works, Cambusnethan ronmaster, has recently patented improvements in machinery or apparatus for boring and winding for mining purposes, by means of steam-power in lieu of manual labour. One arrangement consists of a portable or locomotive engine, constructed with double cylinders arranged on the upper part of the engine, the piston-rods of which are connected to and give motion to a horizontal crank shaft, the bearings of which are carried in brackets fixed to a convenient part of the engine or its framing. This shaft has keyed to it a pinion, which gears with a spur-wheel carried upon a horizontal shaft, having its bearings arranged on a separate frame contiguous to the engine. The spur-wheel shaft has upon it a cam or series of cams, arranged parallel to each other, and fitted so as to be readily moved to and fro on the shaft. Immediately in front of this arrangement is the framing which supports the lever for imparting the vertical percussive motion to the boring-rods. The backward end of this lever extends within reach of the cam, so that when motion is communicated thereto from the engine the end of the lever is depressed each time the cam comes round, and a corresponding rise and fall is imparted to the boring-tool. Where a differential cam is used the height to which the boring rods are raised is regulated by moving the cam along the shaft, so as to bring a longer or shorter projecting part opposite the end of the actuating lever. In addition to this adjustment, there is fitted to the lifting lever of the boring-rods a box capable of adjustment along the backward portion of the lever. A weight is placed in the box, so that by adjusting its position on the lever nearer to or away from the fulcrum, the force of the blow may be regulated to a nicety. The rotatory motion which is required to be imparted to the boring-tool is given by hand.



The annexed engraving represents an elevation of a portable engine, mounted upon wheels *A*. In the smoke-box are arranged the cylinders, the piston-rods working out through stuffing-boxes in the end covers. The ends of the piston-rods are connected to guide-blocks, which work to and from in the guides *E*. To the cross heads of the guide blocks are fitted the brasses of the connecting rods *F*, which are attached in the usual way to the crank shaft *G*, which carries the eccentrics for actuating the slide-valves, either direct or through the application of the "link motion," which admits of the engines working either way in drawing and lowering the rods or pump. The crank-shaft *G*, which is carried in pedestal bearings on the circumference of the boiler *B*, has fitted to each extremity a fly-wheel *H*, and immediately inside each wheel a pulley, round which the endless chain *J* passes. These belts are carried round and give motion to the wheels *K* on a cross shaft. This shaft is carried in bearings projecting from the front part of the engine. In the centre of the shaft is fitted a snail *M*, the rotatory motion of which imparts a reciprocatory movement to the two levers *N*. These levers are arranged parallel to one another, and practically form one; they are centred upon a stud, which is carried in brackets pendent from the under part of the boiler, and between the levers is fitted an anti-friction roller, with which the snail *M* comes in contact as it rotates. The free ends of the levers *N* are connected by a pin to the lower end of the adjustable link *O*, the levers having holes in them to admit of their being shortened. The upper end of the link is connected to a screw, which works through a nut in the end of the lever *Q*, and is actuated by the hand-wheel *R*, by means of which the link may be moved to and fro in the slot of the lever *Q*; this lever has formed in it a series of holes *S*, through one of which is passed a shaft *T*, which is carried in bearings arranged on the framing *U*. The holes *S* afford the means of shifting the centre of the lever *Q*, and so increasing or decreasing the longer, or working, portion of it. The end of the lever *Q* carries a hook, to which is slung the cross handle *V* carrying the boring-rods *W* and boring-tool. The lever *Q* also carries a box or other suitable receptacle *X*, for holding a weight to counterbalance the weight of the boring-rods *W*. The box *X* is adjustable along the lever *Q*, so that its position on the lever may more or less assist the rise of the boring-rods. When the engine is put in motion the rotatory action of the snail *M* causes the levers *N* to reciprocate in a vertical plane, and this motion is imparted to the lever *Q*, and through it in an increased degree consequent upon the compound arrangement of the levers to the lever *Q*. The shortening or lengthening of the levers admitting of a considerable range of motion being imparted to the end of the lever *Q*, and through it to the boring-rods. In this manner an extremely gentle rise and fall may be given to the boring-rods, and this may be increased to any practicable extent. On the cross shaft are carried loosely two winding-barrels or drums *Y*, either of which may be caused to rotate with the shaft at pleasure by means of a coupling, actuated by a hand-lever. Upon these drums *Y* are wound the ropes *a* and *b*; the rope or chain *a* serves to raise the boring-rods, and the rope *b* for lowering and raising the pump. The ropes or chains *a* and *b* are carried over the pulley *c* and *d*, which are supported by the ordinary tripod frame *e*, erected over the boring. By means of the hand-levers, either of the winding-barrels or drums *Y* may be brought into use, and the lever *Q* may be meanwhile thrown out of use, either by detaching it from the levers *N*, or by causing the box or counterweight *X* to preponderate, and so depress the backward end of the lever. To prevent the levers *N* from rising too high, an elastic buffer *f* is fitted to two stakes or pillars driven into the ground.—*Mechanics' Magazine.*

SAFETY APPARATUS FOR MINE SHAFTS.





Although a large number of inventions have been from time to time introduced for the prevention of accidents in mine shafts, whether through breakage of the ropes or from over-winding, it cannot be doubted that there was still ample room for the application of other and more simple contrivances. A new apparatus has been patented by Messrs. Z. Wright and Son, of Upper Wortley, near Leeds, and as the invention has been in practical operation for several months, with both wooden and iron guide-rods, and has upon every occasion where its merits have been tested proved thoroughly efficient, we take the present opportunity of publishing an illustrated description. This invention is not like others, whose safety entirely depends on springs, which are liable to break or lose their tension, and thus become useless; but when the rope breaks the weight of the cage and contents falls upon the longer ends of the four levers AA, Fig. 1, thereby pressing the shorter ends against the guide-rods BB, and with the leverage thus obtained, so holding the cage fast with whatever weight may be in it, and the greater the weight the firmer will be the hold upon the rods. When the rope or suspending medium is perfect and entire, the levers are drawn out of contact with the guide-rods, as shown in Fig. 1, thus allowing of the uninterrupted ascent and descent of the cage in the shaft; but should the rope break, or be otherwise disconnected, the springs CC cause the levers immediately to grip the guide rods, and so hold the cage fast. In this way it will be perceived that the springs have not the weight of the cage to hold (as in other inventions for the same object), but merely to cause the levers immediately to grip the rods. Fig. 1 shows how the apparatus is adapted to iron or wire-rope conducting rods. When the invention is applied to wooden guide-rods, the only difference made is that the guides are modified to fit the rod, and the ends of the levers furnished with sharp teeth, which take into and grip the wood.

Another most important improvement in this invention is the hand-lever D. Should danger be apprehended, or from whatever motive or reason it may be desirable to stop the cage in its descent, anyone in the cage by pressing this hand-lever instantly arrests the further descent of the apparatus, and throws the weight of the cage upon the four levers, which impinge upon the guide-rods, and hold thereon until raised by the winding-engine. Miners when within this cage must feel themselves doubly secure, as by this hand-lever they are able to stop themselves, in addition to the apparatus being perfectly self-acting. The second part of this invention is the spring catch E, Fig. 2. Should the cage from any cause be drawn too high, this "catch" is drawn through a suitably formed circle fixed below the pulley; the sides, F, of the catch are thereby compressed. The pins G are drawn out of the "catch-piece" H by the cross-rods I; the cage is thereby released and held by the conducting rods, thus effectually preventing any accident from over-winding.

In addition to the testimonials of Messrs. Ingham and Sons, and Mr. W. D. Cliff, of works in the neighbourhood of Wortley, the inventors have just received the following from Mr. Geo. Ellison, of Wentworth Colliery, Birstal:—I have very great pleasure in bearing testimony to the efficiency of your patent safety-cage, and also the catch for the prevention of over-pulling. Having now fairly tested both the cage and catch, I can with great confidence recommend them to all colliery proprietors, not only for the preservation of the lives and limbs of the workmen, but also in a pecuniary point of view, in preventing such serious damage as often accrue, from the breaking of the rope, or from over-drawing. I have fixed your apparatus at one of my pits, and intend to apply it to the remainder immediately. I shall be glad at any time to allow colliery proprietors and others to inspect the same.—G. ELLISON.

AYTOUN'S PATENT SAFETY CAGE FOR MINES.

SAFETY FOR THE MINER.—An accident occurred at one of the pits belonging to Earl Granville, at Star Green, Hanley Potteries, by which ten men were killed and other ten severely injured. At Half-past Two a "cage," containing fourteen men, was being drawn up the shaft of the "big pit," while another cage with six or seven men in it was going down at the same time. As the ascending cage drew near the surface the signal-bell in the engine-room sounded as usual, in order that the engine might be at once stopped. The engine-tender was, however, too late in attending to his signal, and the consequence was that one cage was drawn up beyond its proper point, while the other went to the bottom of the shaft with a heavy shock. The ascending cage was drawn up till it reached the wheel over which the rope attached to it worked, and was being taken round, when the whole fourteen men, with one exception, were precipitated beneath; six fell down the haft, and were dashed to pieces; three fell on the pavement at the pit's mouth, and one on the iron pavement, and was killed on the spot; four who were thrown on the ground received fearful injuries. The occupants of the descending cage were all more or less injured by their fall, but none of them were killed. We have over and over again drawn the attention of mine proprietors and viewers to the imperative necessity of adopting means, now proved to be wholly effectual, for the prevention of lamentable accidents like this. Will colliery owners never listen to the pleading voice on behalf of the poor miners, which tells them that over-winding need never occur? In the present case of Earl Granville's pit, had such a disengaging catch and safety cage as is shown in our plate 232, for December, 1858, been fitted up, the most careless engine man could not have brought about any casualty whatever. The apparatus to which we have referred is that invented by Mr. R. Aytoun, of 3, Fettes-row, Edinburgh, and we quote it as being the most recent successful attempt at a safety cage.—*Practical Mechanics' Journal*, January, 1860.

FRIGHTFUL COLLIERY ACCIDENT.—An appalling occurrence happened near Wolverhampton on Saturday morning, which resulted in the instant death of seven persons. At a little before Six o'clock the colliers at the Blue Fly Pit, at the Wednesfield Heath Colliery of Mr. H. B. Whitehouse, assembled around the pit's mouth to descend to their work, down a shaft nearly 100 yards in depth. During the previous night the engine had been used in drawing water from the pit, and on Saturday morning the night engine-tender had left duty, and the engine-tender for the day had taken the engine in charge. On passing each other, the engine-tender who was going off duty said to his successor, "It's all right." Presuming upon the supposed truthfulness of the statement, the day engine-tender went confidently into the engine-house, and the colliers received the customary signal to jump into the skip; four men and three boys obeyed the signal, the engine was set in motion, and the skip raised a few inches from the wagon or platform that on such occasions forms the temporary covering to the mouth of the shaft, and the wagon was drawn away to allow the skip to descend. The engine had been scarcely reversed before it was found that the drum upon which the wire-rope that held the skip was coiled had been imperfectly connected with the engine. In no way held in check, therefore, it began to revolve with great rapidity, and in an instant the men and boys in the skip were literally dashed to atoms at the bottom of the shaft.—*Scotsman*, January 24, 1860.

These two accidents are given for the consideration of those who believe that safety cages are unnecessary where attention is paid to the state of the rope. In neither of these cases were the casualties owing to any deficiency in the rope or gearing, and yet seventeen lives have been sacrificed, not one of which would have been lost had a safety cage with its disengaging catch been in use.

DESCRIPTION OF CAGE.

The only novelty in this cage lies in the upper slides, or shoes, and their appendages. These slides, or shoes, B C, are two in number; but being placed on opposite sides of the cage, only one of them can be seen in the drawing. Each of these slides has a single bolt, or stud, B, by which it is attached to the cage, and around which it turns; a long arm, A B, to the extremity of which the winding chain is attached; a stop, H, which prevents the arm from being pulled above the horizontal line; and a spring, E F, which lowers it when the winding chain is slack.

From this description it is easily seen that, in the event of the rope or gearing giving way, as in Fig. 2, the springs, E F, so tilt the shoes, or slides, B C, that they immediately seize hold of the guide rods in the same manner as a boring key in the hands of a miner lays hold of the boring rods, and with the same tenacity of grip; and although the rope should come down on the top of the cage, the only effect would be to cause the shoes to dig deeper into the guide rods, and thus to make the hold more secure. The means of arresting the cage in its descent being thus provided, there need be no hesitation in adopting the "disengaging catch," whereby, in a case of over-winding, the rope is let go and the cage remains safely suspended from the guide rods.

It may be mentioned that the safety apparatus costs little money, can be fitted to existing cages, and is alike applicable to guide rods of iron or wood. Moreover, when brought into action it does not injure the guide rods, and, consequently, after an accident, in which lives and property may have been saved, the winding may be proceeded with almost immediately.

To ensure the speedy adoption of this invention, the license fee for a single cage, during the existence of the patent right, has been limited for the present to £1.

For licenses, reference to parties who use the cage, or further information, application may be made to ROBERT AYTOUN, 3, Fettes-row, Edinburgh.

TO BRASSFOUNDERS, ENGINEERS, REFINERS, &c.—The PATENT PLUMBAGO CRUCIBLE COMPANY beg to CALL the ATTENTION of all users and shippers of melting pots to the GREAT SUPERIORITY of the PATENT CRUCIBLES, which have been used during the last three years by some of the largest melters in England and abroad. In addition to their capabilities of melting an average of from 35 to 40 pourings, they are unaffected by change of temperature, never crack, but can be used till worn out, requiring only one annealing for several days' work, and become heated much more rapidly than ordinary pots, EFFECTING thereby a SAVING of more than FIFTY PER CENT. in time, labour, fuel, and waste. The Patent Plumbago Crucible Company also manufacture and import clay crucibles, muffles, portable furnaces, sublimate pans and covers, glass pots, all descriptions of fire-standing goods, and every requisite for the assayer and dentist.

Also, sole proprietors of fine POWDERED PURE FLOUR PLUMBAGO, which they can confidently recommend for anti-friction purposes, being an impalpable powder, and warranted perfectly free from grit and any impurity. For ordinary polishing purposes it will be found superior to any of the black leads offered. Price, £27 10s. per ton; 30s. per cwt. Samples of 28 lbs. forwarded on receipt of 84. Packages free.

For Lists, Testimonials, &c., apply to the BATTERSEA WORKS, London, S.W. 163

HALEY'S PATENT LIFTING JACK,

MANUFACTURED BY THE INVENTOR,

JOSEPH HALEY,

ALBION STREET, GAYTHORN, MANCHESTER.

SCREW JACKS, SHIP JACKS.

SLIDE AND CENTRE LATHES, PLANING, SHAPING, BORING, DRILLING SCREWING, WHEEL CUTTING, AND OTHER MACHINES.

RIVET MAKING MACHINES. 164

CLAYTON, SHUTTLEWORTH, AND CO., AGRICULTURAL AND GENERAL ENGINEERS, LINCOLN, and 78, LOMBARD STREET, LONDON.

MANUFACTURERS OF

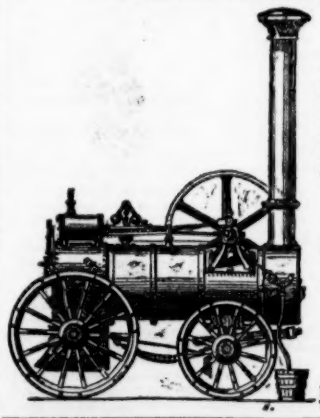
PORTABLE and FIXED STEAM ENGINES,

Which are adapted for every purpose to which steam-power can be applied. When intended for winding they are fitted with reversing link motion and requisite gearing. The portable engines are easy of removal from place to place, and may be set to work immediately on arrival.

COMBINED THRASHING MACHINES,

Which dress the corn ready for market at one operation.

GRINDING and MORTAR MILLS, SAWING MACHINERY, PUMPS for IRRIGATION and MINING PURPOSES. 165



Full particulars and estimates supplied on application to CLAYTON, SHUTTLEWORTH, and Co., as above.

HALL AND WELLS, PATENTEES AND MANUFACTURERS OF SUBMARINE TELEGRAPH CORES, CABLES, &c.—TELEGRAPH CONDUCTORS INSULATED with INDIA RUBBER at £5 per mile and upwards. CORES WARRANTED to STAND the USUAL TEST for INSULATION. Further particulars as to price of cores, cables, &c., can be had on application at 60, Aldermanbury, City, E.C.; and Steam Mills, Mansfield-street, Borough-road, Southwark, S.E.

Copper wire covered with silk, cotton, or any other material, to order. 166

EBONITE!—TELEGRAPH INSULATORS made of EBONITE. EBONITE in SHEET, TUBES, and RODS, or manufactured into various articles of utility and ornament, being calculated to supersede metal, hard woods, and ivory at present in use.

INDIA RUBBER.—INDIA RUBBER STEAM PACKING in ROPE, SHEET, RINGS, &c., intended for railway and machinery appliances, unvulcanised and vulcanised.

S. W. SILVER AND CO., 3 and 4, BISHOPSGATE WITHIN, E.C. (Opposite the London Tavern).

WORKS—SILVERTOWN, ESSEX, opposite Her Majesty's Dockyards, Woolwich. 167

PATENT SAFETY FUSE.—The GREAT EXHIBITION PRIZE MEDAL was AWARDED to the MANUFACTURERS of the ORIGINAL SAFETY FUSE, BICKFORD, SMITH DAVEY, and PRYOR who beg to inform Merchants, Mine Agents, Railway Contractors, and all persons engaged in Blasting Operations, that, for the purpose of protecting the public in the use of a genuine article, the PATENT SAFETY FUSE *has now a thread wrought into its centre*, which, being patent right, infallibly *distinguishes it from all imitations*, and ensures the continuity of the gunpowder.

This Fuse is protected by a Second Patent, is manufactured by greatly improved machinery, and may be had of any length and size, and adapted to every climate.

Address,—BICKFORD, SMITH, DAVEY, and PRYOR, Tuckingmill, Cornwall. 168

SAFETY FUSE.—Messrs. WILLIAM BRUNTON AND CO., PENHALLICK, POOL, near CAMBORNE, CORNWALL, and BRYMBO, near WREXHAM, MANUFACTURERS OF FUSE, of every size and length, as exhibited in the Great Exhibition of 1851, and supplied to the Royal Arsenal at Woolwich, the Arctic Expedition, and every part of the globe.

For the convenience of their customers and others in the North, W. BRUNTON and Co. have recently erected a branch manufactory at Brymbo, near Wrexham, where, as at Cornwall, they are at all times PREPARED to EXECUTE UNLIMITED ORDERS for SUPPLYING FUSE upon warrant that it will prove equal to, if not better than, any to be procured elsewhere. 169 170

LONDON: Printed by RICHARD MIDDLETON, and published by HENRY ENGLISH (the proprietors), at their office, 26, FLEET-STREET, where all communications are requested to be addressed. [April 27, 1861.